

CONSULTING AGREEMENT

This Consulting Agreement (this “**Agreement**”) is made and entered into as of January 1st, 2021 (the “**Effective Date**”) by and between the Monterey Bay Aquarium Research Institute (MBARI), a California non-profit organization (the “**Company**”), and Open Source Robotics Corporation, a California corporation (“**Consultant**”) (each herein referred to individually as a “**Party**,” or collectively as the “**Parties**”).

The Company desires to retain Consultant, on an independent contractor basis, to perform consulting services for the Company, and Consultant is willing to perform such services, on the terms described below. In consideration of the mutual promises contained herein, the Parties agree as follows:

1. Services and Compensation

Consultant shall perform the consulting services described in **Exhibit A** (the “**Services**”) for the Company (or its designee), and the Company agrees to pay Consultant the compensation described in **Exhibit A** for Consultant’s performance of the Services.

2. Confidentiality

A. **Definition of Confidential Information.** “**Confidential Information**” means any non-public information that relates to the business and/or products, research or development of a Party, its affiliates or subsidiaries, or to a Party’s, its affiliates’ or subsidiaries’ technical data, trade secrets, or know-how, including, but not limited to, research, product plans, or other information regarding a Party’s, its affiliates’ or subsidiaries’ products or services, software, developments, inventions, processes, formulas, technology, designs, drawings, engineering, hardware configuration information, and other business information disclosed by a Party, its affiliates or subsidiaries. Notwithstanding the foregoing, Confidential Information shall not include any such information which the other Party can establish (i) was publicly known or made generally available prior to the time of disclosure to a Party; (ii) becomes publicly known or made generally available after disclosure to a Party through no wrongful action or inaction of such Party; or (iii) is in the rightful possession of a Party, without confidentiality obligations, at the time of disclosure as shown by such Party’s then-contemporaneous written records.

B. **Nonuse and Nondisclosure.** During and after the term of this Agreement, each Party (in such capacity, “**Recipient**”) will hold in the strictest confidence, and take all reasonable precautions to prevent any unauthorized use or disclosure of Confidential Information of the other Party (in such capacity, “**Discloser**”), and each Recipient will not (i) use the Confidential Information for any purpose whatsoever other than as necessary for the performance of Recipient’s obligations under this Agreement, or (ii) disclose the Confidential Information to any third party without the prior written consent of an authorized representative of the Discloser. A Recipient may disclose Confidential Information to the extent compelled by applicable law; *provided however*, prior to such disclosure, Recipient shall provide prior written notice to Discloser and use best efforts to assist Discloser in seeking a protective order or such similar confidential protection as may be available under applicable law, at Discloser’s expense. Each Recipient agrees that no ownership of Confidential Information is conveyed to a Discloser. Without limiting the foregoing, Recipient shall not use or disclose any Discloser property, intellectual property rights, trade secrets or other proprietary know-how of the Discloser to invent, author, make, develop, design, or otherwise enable others to invent, author, make, develop, or design identical or substantially similar designs

as those developed under this Agreement for any third party. Recipient agrees that Recipient's obligations under this Section 2.B shall continue after the termination of this Agreement.

C. **Other Confidential Information.** Each Party agrees that such Party will not improperly use, disclose, or induce the other Party to use any proprietary information or trade secrets of any former or concurrent employer of such Party or other person or entity with which such Party has an obligation to keep in confidence. Each Party also agrees that such Party will not bring onto the other Party's premises or transfer onto the other Party's technology systems any unpublished document, proprietary information, or trade secrets belonging to any third party unless disclosure to, and use by, the other Party has been consented to in writing by such third party.

D. **Third Party Confidential Information.** Each Party recognizes that the other Party has received and in the future will receive from third parties their confidential or proprietary information subject to a duty on the other Party's part to maintain the confidentiality of such information and to use it only for certain limited purposes. Each Party agrees that at all times during the term of this Agreement and thereafter, such Party owes the other Party and such third parties a duty to hold all such confidential or proprietary information in the strictest confidence and not to use it or to disclose it to any person, firm, corporation, or other third party except as necessary in carrying out such Party's obligations under this Agreement consistent with the other Party's agreement with such third party.

3. Ownership

A. **Assignment of Inventions.** Consultant agrees that all right, title, and interest in and to any copyrightable material, publications, inventions, improvements, developments, discoveries and trade secrets conceived, discovered, authored, invented, developed or reduced to practice by Consultant, solely or in collaboration with others, in connection with performing the Services under this Agreement and any intellectual property rights relating to the foregoing (collectively, "**Inventions**"), are the sole property of the Company.

B. **Pre-Existing Materials.** Subject to Section 3.A, Consultant agrees that if, in the course of performing the Services, Consultant knowingly incorporates into any Invention or utilizes in the performance of the Services any pre-existing invention, discovery, original works of authorship, development, improvements, trade secret, concept, or other proprietary information or intellectual property right owned by Consultant or in which Consultant has an interest ("**Prior Inventions**"), Consultant agrees to grant a nonexclusive, royalty-free, perpetual, irrevocable, transferable, worldwide license (with the right to grant and authorize sublicenses) to make, have made, use, import, offer for sale, sell, reproduce, distribute, modify, adapt, prepare derivative works of, display, perform, and otherwise exploit such Prior Inventions, without restriction, including, without limitation, as part of or in connection with such Invention, and to practice any method related thereto, to the extent that Consultant has the authority to provide such a grant.

C. **Moral Rights.** Any assignment to the Company of Inventions includes all rights of attribution, paternity, integrity, modification, disclosure and withdrawal, and any other rights throughout the world that may be known as or referred to as "moral rights," "artist's rights," "droit moral," or the like (collectively, "**Moral Rights**"). To the extent that Moral Rights cannot be assigned under applicable law, Consultant hereby waives and agrees not to enforce any and all Moral Rights, including, without limitation, any limitation on subsequent modification, to the extent permitted under applicable law.

D. **Maintenance of Records.** Consultant agrees to keep and maintain adequate, current, accurate, and authentic written records of all Inventions made by Consultant (solely or jointly with others) during the term of this Agreement, and for a period of one (1) year thereafter.

E. **Further Assurances.** Consultant agrees to provide reasonable assistance to Company, or its designee, at the Company's expense, to attempt to secure the Company's rights in Inventions, including the disclosure to the Company of all pertinent information and data with respect thereto, the execution of all applications, assignments and all other instruments that is necessary in order to apply for, register, obtain, maintain, defend, and enforce such rights, and in order to deliver, assign and convey to the Company, its successors, assigns and nominees the sole and exclusive right, title, and interest in and to all Inventions. Consultant further agrees that Consultant's obligations under this Section 3.E shall continue after the termination of this Agreement.

4. **Conflicting Obligations** Consultant represents and warrants that Consultant has no agreements, relationships, or commitments to any other person or entity that conflict with the provisions of this Agreement, Consultant's obligations to the Company under this Agreement, and/or Consultant's ability to perform the Services. Consultant will not enter into any such conflicting agreement during the term of this Agreement.

5. **Return of Company Materials**

Upon the termination of this Agreement, or upon Company's earlier request, Consultant will immediately deliver to the Company, any and all Company property, including, but not limited to, Confidential Information, all devices and equipment belonging to the Company, all Company system access provide in connection with the work as described in Exhibit A, those records maintained pursuant to Section 3.D that Consultant may have in Consultant's possession or control.

6. **Term and Termination**

A. **Term.** The term of this Agreement will begin on the Effective Date of this Agreement and will continue until the earlier of (i) final completion of the Services or (ii) termination as provided in Section 6.B.

B. **Termination.** Either Party may terminate this Agreement upon giving the other Party fourteen (14) days prior written notice of such termination pursuant to Section 11.G of this Agreement. Either Party may terminate this Agreement immediately and without prior notice if other Party is in breach of any material provision of this Agreement.

C. **Survival.** Upon any termination, all rights and duties of the Company and Consultant toward each other shall cease except:

(1) The Company will pay, within thirty (30) days after the effective date of termination, all amounts owing to Consultant for Services completed and accepted by the Company prior to the termination date and related reimbursable expenses, if any, submitted in accordance with the Company's policies and in accordance with the provisions of Article 1 of this Agreement; and

(2) Article 2 (Confidentiality), Article 3 (Ownership), Article 5 (Return of Company Materials), Article 6 (Term and Termination), Article 7 (Independent Contractor; Benefits),

Article 8 (Indemnification), Article 9 (Limitation of Liability), Article 11 (Disputes), and Article 11 (Miscellaneous) will survive termination or expiration of this Agreement in accordance with their terms.

7. Independent Contractor; Benefits

A. **Independent Contractor.** It is the express intention of the Company and Consultant that Consultant perform the Services as an independent contractor to the Company. Nothing in this Agreement shall in any way be construed to constitute Consultant as an agent, employee or representative of the Company. Consultant shall retain sole control over the manner and means by which the Services are performed, reserves the right to determine the assignment of its personnel, and may engage third parties in the performance of the Services. Without limiting the generality of the foregoing, Consultant is not authorized to bind the Company to any liability or obligation or to represent that Consultant has any such authority. Consultant agrees to furnish (or reimburse the Company for) all tools and materials necessary to accomplish this Agreement and shall incur all expenses associated with performance, except as expressly provided in **Exhibit A**. Consultant acknowledges and agrees that Consultant is obligated to report as income all compensation received by Consultant pursuant to this Agreement. Consultant agrees to and acknowledges the obligation to pay all self-employment and other taxes on such income.

B. **Benefits.** The Company and Consultant agree that Consultant will receive no Company-sponsored benefits from the Company where benefits include, but are not limited to, paid vacation, sick leave, medical insurance and 401(k) participation. If Consultant is reclassified by a state or federal agency or court as the Company's employee, Consultant will become a reclassified employee and will receive no benefits from the Company, except those mandated by state or federal law, even if by the terms of the Company's benefit plans or programs of the Company in effect at the time of such reclassification, Consultant would otherwise be eligible for such benefits.

8. Indemnification

Each Party (the "**Indemnifying Party**") will defend the other Party and its affiliates, and their respective directors, officers, attorneys, agents, employees and assigns (the "**Indemnified Parties**"), at the Indemnifying Party's cost and expense, and will indemnify and hold harmless the Indemnified Parties from and against all suits, claims, losses, damages, and expenses, including, without limitation costs and reasonable attorneys' fees (collectively, "**Claims**") arising from any grossly negligent or intentional act or omission of the Indemnifying Party, its employees or agents, while performing its obligations hereunder, including, without limitation Claims resulting from death, personal injury, or tangible property damage; provided that the Indemnified Party provides the Indemnifying Party with prompt written notice of the claim, information, and all reasonable assistance in the defense of the claim, at the Indemnifying Party's expense, and sole authority to defend or settle the claim.

9. Limitation of Liability

IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES (INCLUDING FOR LOSS OF USE, BUSINESS OR PROFITS, AND CLAIMS FOR SUCH DAMAGES BY A THIRD PARTY) RELATED TO OR ARISING OUT OF THIS AGREEMENT, HOWEVER CAUSED, ON ANY THEORY OF LIABILITY, WHETHER IN AN ACTION IN CONTRACT, STRICT LIABILITY, TORT (INCLUDING NEGLIGENCE OR WILLFUL MISCONDUCT) OR OTHERWISE, AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. CONSULTANT'S LIABILITY TO THE

COMPANY UNDER ANY PROVISION OF THIS AGREEMENT, OR ANY TRANSACTION CONTEMPLATED BY THIS AGREEMENT, SHALL BE LIMITED TO THE AMOUNT OF FEES ACTUALLY PAID BY THE COMPANY TO CONSULTANT UNDER THIS AGREEMENT. ALL OF CONSULTANT'S EXPENDITURES WITH RESPECT TO ANY LIABILITY RELATED TO THIS AGREEMENT SHALL BE AGGREGATED TO DETERMINE SATISFACTION OF THE LIMIT.

10. Disputes

If any dispute arises between the Parties with respect to this Agreement, the Parties shall negotiate in good faith to resolve it. If the negotiations do not resolve the dispute, then the Parties agree to mediate such dispute before seeking any formal adjudication process. Either Party may initiate a mediation by giving written notice to the other, and the Parties shall within 30 days thereafter, agree on a mediator and set a mutually acceptable date for the mediation. The Parties shall bear equally the cost of the mediator's fees and expenses, but each Party shall pay its own legal fees and costs associated with the mediation. If the mediation does not resolve the dispute to the Parties' mutual satisfaction, then either Party may initiate binding arbitration conducted by the American Arbitration Association under its rules. The dispute resolution process described in this Section 10 shall be the exclusive remedy of the Parties for any dispute concerning this Agreement; provided, however, that nothing in this Section 10 shall limit a Party's right to seek a provisional remedy from a court of competent jurisdiction in circumstances where such relief is deemed necessary.

11. Miscellaneous

A. **Governing Law; Consent to Personal Jurisdiction.** This Agreement shall be governed by the laws of the State of California, without regard to the conflicts of law provisions of any jurisdiction. To the extent that any lawsuit is permitted under this Agreement, the Parties hereby expressly consent to the personal and exclusive jurisdiction and venue of the state and federal courts located in Santa Clara County, California.

B. **Assignability.** This Agreement will be binding upon each Party's successors and its assigns. There are no intended third-party beneficiaries to this Agreement, except as expressly stated. Consultant may assign this Agreement and its rights and obligations under this Agreement to any successor to all or substantially all of Consultant's relevant assets, whether by merger, consolidation, reorganization, reincorporation, sale of assets or stock, or otherwise.

C. **Entire Agreement.** This Agreement constitutes the entire agreement and understanding between the Parties with respect to the subject matter herein and supersedes all prior written and oral agreements, discussions, or representations between the Parties. Each Party represents and warrants that it is not relying on any statement or representation not contained in this Agreement. To the extent any terms set forth in any exhibit or schedule conflict with the terms set forth in this Agreement, the terms of this Agreement shall control unless otherwise expressly agreed by the Parties in such exhibit or schedule.

D. **Headings.** Headings are used in this Agreement for reference only and shall not be considered when interpreting this Agreement.

E. **Severability.** If a court or other body of competent jurisdiction finds, or the Parties mutually believe, any provision of this Agreement, or portion thereof, to be invalid or unenforceable, such

provision will be enforced to the maximum extent permissible so as to effect the intent of the Parties, and the remainder of this Agreement will continue in full force and effect.

F. **Modification, Waiver.** No modification of or amendment to this Agreement, nor any waiver of any rights under this Agreement, will be effective unless in a writing signed by the Parties. Waiver by a Party of a breach of any provision of this Agreement will not operate as a waiver of any other or subsequent breach.

G. **Notices.** Any notice or other communication required or permitted by this Agreement to be given to a Party shall be in writing and shall be deemed given (i) if delivered personally or by commercial messenger or courier service, (ii) when sent by confirmed facsimile, or (iii) if mailed by U.S. registered or certified mail (return receipt requested), to the Party at the Party's address written on the signature page to this Agreement or at such other address as the Party may have previously specified by like notice. If by mail, delivery shall be deemed effective three business days after mailing in accordance with this Section 11.G.

H. **Signatures.** This Agreement may be signed in two counterparts, each of which shall be deemed an original, with the same force and effectiveness as though executed in a single document.

(Signature page follows)

IN WITNESS WHEREOF, the Parties hereto have executed this Consulting Agreement as of the date first written above.

COMPANY	OPEN SOURCE ROBOTICS CORPORATION
By:	By:
Name:	Name:
Title:	Title:
Address for Notice:	Address for Notice:

EXHIBIT A

SERVICES AND COMPENSATION

Background

Company requires support for improving their simulation of robotic marine systems. Consultant has expertise in ROS and Ignition Gazebo development as well as integration and testing which will help Company to leverage the software on their platforms.

Scope of Work

Consultant will work with Company to develop and improve robotic system simulations and associated open source projects in ways that help them leverage the open source systems to test and deploy their robotic systems effectively. This will include improving both the simulation of the robotic systems themselves as well as the environment including the simulations of the scientific models of phenomena under study as outlined in the LRAUV roadmap. See statement of work below.

The work will be performed by Consultant's staff and billed according to hours consumed based on the experience and skill level of the staff members.

Consultant's standard labor rates for this hourly work are as follows

- Technical staff I: \$125.00
- Technical staff II: \$170.00
- Technical staff III: \$215.00
- Technical staff IV: \$260.00
- Technical staff V: \$370.00

In recognition of Company's non-profit status, Consultant will discount these rates by 10% for this project.

Base

During the first quarter the Consultant will work with the MBARI team to develop a demonstration of the simulation with the minimum viable product to demonstrate that the simulation will be able to meet the needs of the MBARI team. At the end of the first quarter, the results of this demonstration will be presented to an MBARI design review panel for validation before continuing.

The minimum billing amount for any month is \$10,000. If actual usage is less, Consultant will invoice for the minimum amount.

The maximum billing amount for any month is not to exceed \$40,000.

Option 1

After a successful demonstration of the viability of the project in the Design Review, the Consultant will continue to support the development of the multi-vehicle test bed prioritizing the features requested from the LRAUV roadmap.

The estimated level of effort will be 1 FTE

The minimum billing amount for any month is \$10,000. If actual usage is less, Consultant will invoice for the minimum amount.

The maximum billing amount for any month is not to exceed \$40,000.

Option 2

If requested by the Company, Consultant will supply an additional FTE to accelerate development with 3 months' notice.

The minimum billing amount for any month is \$10,000. If actual usage is less, Consultant will invoice for the minimum amount.

The maximum billing amount for any month is not to exceed \$40,000.

Period of Performance

Base: January 1st, 2021 - March 31st, 2021 (3 months)

Option 1: April 1st, 2021 - December 31st, 2021 (9 months)

Option 2: (Adjustable after April 1st, 2021) - December 31st, 2021 (up to 9 months)

Work Requirements

Consultant will provide at the request of Company work which may include the following:

- Development of open source simulation and software as defined on the LRAUV Roadmap.
- Answers to questions
- Recommendations based on research or knowledge of the available products
- Feature enhancements and bug fixes for open source projects
- Testing and debugging of systems

Company will provide access to the LRAUV software repositories on BitBucket.

Schedule

Consultant will keep track of hours worked and submit an invoice at the end of each month. Work execution will be coordinated between Consultant and Company on an ongoing basis. This coordination will include an estimate of the level of work for each month's performance prior to starting the month.

Travel and Materials

Travel and any material purchases for the project will be billed at cost.

MULTI-LRAUV SIMULATION ENVIRONMENT STATEMENT OF WORK

Open Robotics will be contracted to develop all software components needed to support a multi-LRAUV simulation environment. Open Robotics has performed extensive relevant past work, and the proposed tasks build upon the existing open source software ecosystem supported by Open Robotics, including the *Ignition Gazebo* simulator and the ROS programming framework.

Milestone 1 — Basic infrastructure and design review (Q1, 2021)

During the first quarter Open Robotics will work with the MBARI team to develop a demonstration of the simulation with the minimum viable product to eliminate high risk aspects of the implementation and demonstrate that the simulation will be able to meet the needs of the MBARI team. At the end of the first quarter, the results of this demonstration will be presented to an MBARI design review panel for validation before continuing to subsequent phases.

The main technical challenge that requires validation is the ability to meet the faster-than-real-time requirement for the LRAUV simulation and ensure this capability scales well to a multi-vehicle simulation. The ability to run much faster than real-time is critical due to the long deployment durations that are typical for LRAUV (for example, a 3 week deployment at 100x time takes 5 hours to run).

Tasks

1. Create a basic water column environment in Ignition Gazebo to host the simulation, and package with docker based deployment.
2. Create a 3D vehicle model for LRAUV (provided with CAD or approximation that can be open sourced with no risk to MBARI IP).
3. Create simulation actuator plugins for LRAUV Rudder, Elevator, Thruster.
4. Specify the LRAUV/ROS2 interface and integrate the Gazebo simulation with LRAUV software stack. conduct analysis to determine run-time bottlenecks.

Deliverables

1. Basic water column Ignition Gazebo world model.
2. Basic LRAUV Ignition Gazebo vehicle model.
3. Ignition Gazebo plugins for LRAUV Rudder, Elevator, Thruster.
4. LRAUV/ROS2 messaging interface specification.
5. Design review and associated documents.

Milestone 2 — LRAUV vehicle model infrastructure (Q2, 2021)

During this phase Open Robotics will extend the LRAUV vehicle simulation model to include actuator plugins that are unique to the LRAUV and improve the fidelity of the dynamics simulation by including added mass calculations. The environment world model will be extended to include currents which are needed to validate some aspects of the vehicle's dynamics simulation.

Delivered capability: Upon completion, the LRAUV model will be drivable in the simulated environment and the user will be able to run simple missions that do not require inputs from science instruments. The hydrodynamic vehicle simulation will provide a marginal approximation of actual performance.

Tasks

1. Add a current world plugin with positional lookup.
2. Add LRAUV variable buoyancy engine actuator plugin.
3. Add LRAUV mass shifter actuator plugin.
4. Add LRAUV drop-weight actuator plugin.
5. Add LRAUV added mass matrix to the vehicle dynamics simulation.

Deliverables

1. Ignition Gazebo plugin for ocean currents.
2. Ignition Gazebo plugins for LRAUV variable buoyancy engine, mass-shifter, and drop weight.
3. Ignition Gazebo Hydrodynamic Model plugin for LRUAV including added mass.

Milestone 3 — LRAUV sensor data integration (Q3, 2021)

During this phase Open Robotics will develop a standard interface for simulating science instruments and add simulation of basic oceanographic and biological water properties such as temperature, salinity, and chlorophyll concentrations. Inter-vehicle acoustic tracking will be added in support of simulation of coordinated ops. Vehicles populated in the simulated world will be able to sense these properties through virtual sensors.

Delivered capability: Upon completion of this phase, developers will be able to create environmental scenarios such as thermal fronts and productivity hotspots, and simulate science missions that require CTD, and fluorometer inputs. Multi-vehicle tracking using range/bearing will also be supported and it will be possible to recreate simple multi-vehicle campaigns such as CANON at this point.

Tasks

1. Standard interface for science payloads – create a standard LRAUV/ROS2 interface for all scientific payloads to enable logging, playback, and data analysis of environmental scenarios tested in the simulation and ensure scenario reproducibility.
2. Temperature world plugin – add support for water column temperature measurements sourced from a position lookup table.
3. Salinity world plugin – add support for support water column salinity measurements sourced from a position lookup table.

4. Chlorophyll world plugin – add support for water column chlorophyll concentration measurements sourced from a position lookup table.
5. Acoustic comms: range/bearing – add tracking capabilities in support of multi-vehicle science missions.
6. CTD sensor – add a sensor plugin that interacts with the environmental model of temperature, pressure, and salinity levels and provide a realistic sensor reading including modelling sensor noise and inaccuracies.
7. Fluorometer sensor plugin – add a sensor plugin that interacts with the environmental model of the chlorophyll concentrations and provides a realistic sensor reading including modelling sensor noise and inaccuracies.
8. Tools for creating scientifically relevant scenarios – create a tool seeding environmental scenarios of scientific interest and injecting them into the simulation environment.

Deliverables

1. Ignition Gazebo world plugins for Temperature, Salinity, and Chlorophyll.
2. Ignition Gazebo sensor plugins for CTD and Fluorometer.
3. Ignition Gazebo world plugin for acoustic tracking.
4. Software tools for creating scientifically relevant scenarios in Ignition Gazebo.

Milestone 4 — LRAUV dynamics simulation tuning, TethysDash integration, and acoustic data packet transfer (Q4, 2021)

During this phase Open Robotics will tune the LRAUV hydrodynamics simulation model such that it provides a high fidelity approximation of actual vehicle performance, and fully integrate the simulation with LRAUV’s web-based command and control interface (TethysDash: <https://oceanids.mbari.org/dash3>). The team will also add support for inter-vehicle acoustic data packet transfer and acoustic vehicle command and control.

Delivered capability: developers will be able to simulate next-generation multi-vehicle science missions, including advanced multi-vehicle science missions that rely on command reception and data dissemination over the acoustic link such as “Lagrangian hot bunking” (e.g., sampling LRAUV replacement and redirection for extended observations in a given area using multiple assets). Drifting missions will be simulated with accurate vehicle dynamics performance. Users will be able to send missions and commands to the vehicle using TethysDash as if the vehicle is deployed at sea (useful for operator training and automated command and control development).

Tasks

1. Tune LRAUV hydrodynamics simulation – Tune and validate simulated model performance to match near real-world LRAUV performance.
2. Acomms: data packet transfer – Extend the acoustic comms simulation to simulate data packet transfer with realistic connectivity performance in multi-vehicle simulations. **Support from Intuaware (Mike Godin) is required to facilitate this task.**
3. Integration with TethysDash – Integrate TethysDash with simulation so that the interface for scientific operations is the same as in the field and add the dash to the simulation docker image.

Deliverables

1. High fidelity Ignition Gazebo Hydrodynamic Model plugin for LRUAV including tuned damping terms.
2. Ignition Gazebo world plugin for acoustic data packet transfer.
3. Fully integrated and containerized Ignition Gazebo simulation for LRAUV with the LRAUV software stack in the loop and a command and control interface through TethysDash.